REQUEST FOR INFORMATION

STATE OF NORTH CAROLINA **Department of Environmental Quality, Division of Coastal Management**	**REQUEST FOR INFORMATION NO**. 16-32314-WA Due Date: February 4, 2016 at 2:00 PM
Refer ALL Inquiries to: Wanda Andrews Telephone No. 919-707-8538	Issue Date: January 8, 2016 Solicitation: Analysis of Removal of the Southern Component of the New Inlet Dam
Email: wanda.andrews@ncdenr.gov	Using Agency Name: NC DEQ Coastal Management

VENDOR INFORMATION

VENDOR NAME: Cardno, Inc.	EMAIL: Sharon.Niemczyk@cardno.com	
STREET ADDRESS: 5400 Glenwood Avenue, Suite G-03	P.O. BOX IF APPLICABLE:	ZIP:
CITY & STATE & ZIP: Raleigh, North Carolina 27612	TELEPHONE NUMBER: 561-629-3594	
NAME & TITLE OF CONTACT PERSON: Sharon Niemczyk Senior Consultant		

1.0 SUBMISSION INSTRUCTIONS:

A. Email (Preferred):
Submit one emailed electronic copy of this completed Word file to Wanda Andrews at wanda.andrews@ncdenr.gov. It is the responsibility of the Vendor to submit the Request for Information (RFI) by the specified time and date of opening.

Information that assists or otherwise relates to developing specifications for a solicitation by the State is deemed confidential until award of a contract in connection with such solicitation.

B. Mail:

Mail only one Request for Information (RFI) response per envelope. Address envelope and clearly note RFI number as shown below. It is the responsibility of the Vendor to have the RFI in this office by the specified time and date of opening.

MAILING ADDRESS, IF DELIVERED BY US POSTAL SERVICE	**OFFICE ADDRESS, IF DELIVERED BY ANY OTHER MEANS**
RFI NO. 16-32314-WA **Department of Environmental Quality, Coastal Management Division** **Attn: Wanda Andrews** **Box: 1606 MAIL SERVICE CENTER** **Raleigh, NC 27699**	**RFI NO. 16-32314-WA** **Department of Environmental Quality, Coastal Management Division** **Attn: Wanda Andrews** **217 West Jones Street, Suite 5422M, Raleigh, NC 27603-1606**

IMPORTANT NOTE ABOUT MAIL SUBMISSIONS: All Vendors are urged to take the possibility of delay due to submitting via U.S. Mail into account when submitting their response to this RFI.

QUESTIONS

Submit written questions to Wanda Andrews until January 19, 2016 at 11:00 AM. Questions may be submitted by email to wanda.andrews@ncdenr.gov.

2.0 OVERVIEW

The purpose of this Request for Information (RFI) is to acquire information from Vendors regarding their capability to conduct a cost benefit analysis of removal of the Southern Component of the New Inlet Dam and an inventory of the necessary permits and approvals needed to develop and implement a removal plan. The State of North Carolina will use the information received from this RFI as input for potential future contracting strategies. Vendors interested in participating in possible future opportunities are encouraged to respond to this RFI.

It is the objective of this RFI to:

> Develop an understanding of which firms are capable of conducting an analysis of the costs and benefits of removal of the Southern Component of the New Inlet Dam along the Cape Fear River as proposed in the 2015 Appropriations Act Section 14.6.(h) and an inventory of the necessary permits and approvals needed to develop and implement a removal plan.

The following are attached to the RFI as one attachment: 1. 2015 Appropriations Act Section 14.6. (h), 2. Map of the New Inlet Dam, and 3. Pictures of the Southern Component of the New Inlet Dam.

The State is seeking detailed responses to the RFI demonstrating your firm's experience in these areas.

3.0 INSTRUCTIONS

3.1. Schedule

Respondents will have four (4) weeks to prepare and return their submissions to this RFI. Responses must be received by the date, time and the location specified on the first page of this RFI.

3.2. Clarification Questions

Clarification questions will be accepted until January 19, 2016 at 11:00 AM as specified on the first page of this RFI. Clarification questions can be submitted by email (preferred method) to wanda.andrews@ncdenr.gov. An addendum containing any general clarification questions and their answers may be issued as an addendum to this RFI.

3.3. Response

Please note this is a request for information only and not a request for goods or services. The Vendor must bear all costs for preparing this RFI.

4.0 RESPONSE

4.1 Instructions:

Vendors are requested to respond to the requested information below. A response does not bind or obligate the responder to the State of North Carolina to any agreement of provision or procurement of products referenced. No contract can or will be awarded based on submissions.

In order to facilitate the review of the questions, please provide the information in the exact order as below and do not alter the format of this document. You may put responses within this document directly below each question. Please rename this document NC Analysis of Removal of the Southern Component of the New Inlet Dam RFI_VENDOR NAME.doc (.docx also acceptable). In the renamed document title VENDOR NAME should be substituted with your company's name.

4.2 Requested Information:

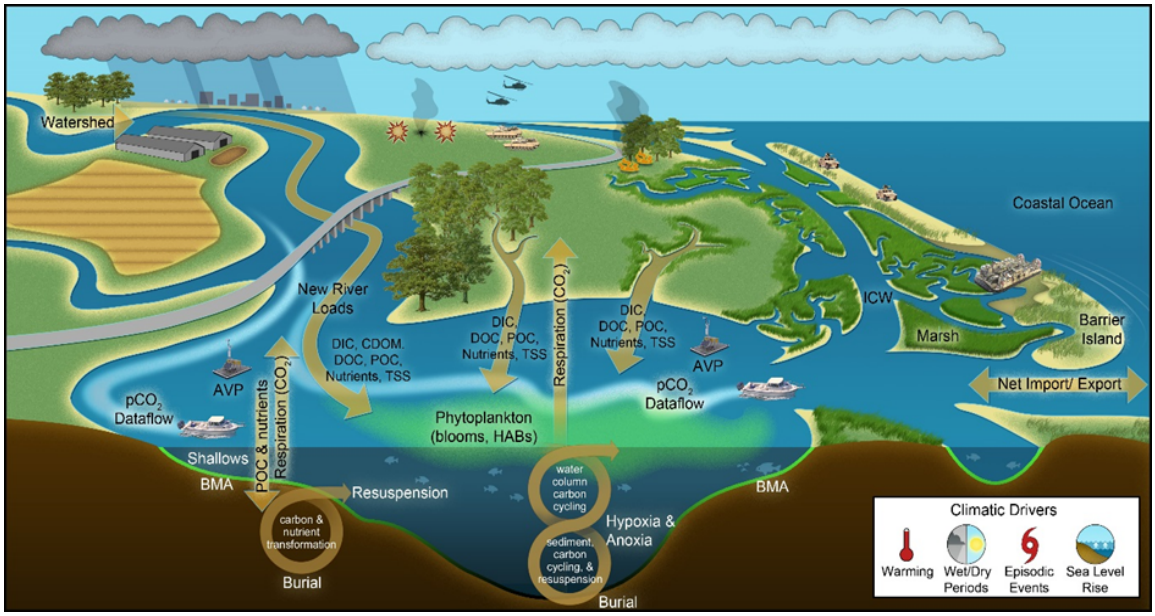
1. **Topic 1: State and Federal Permits, Approvals, and Studies**

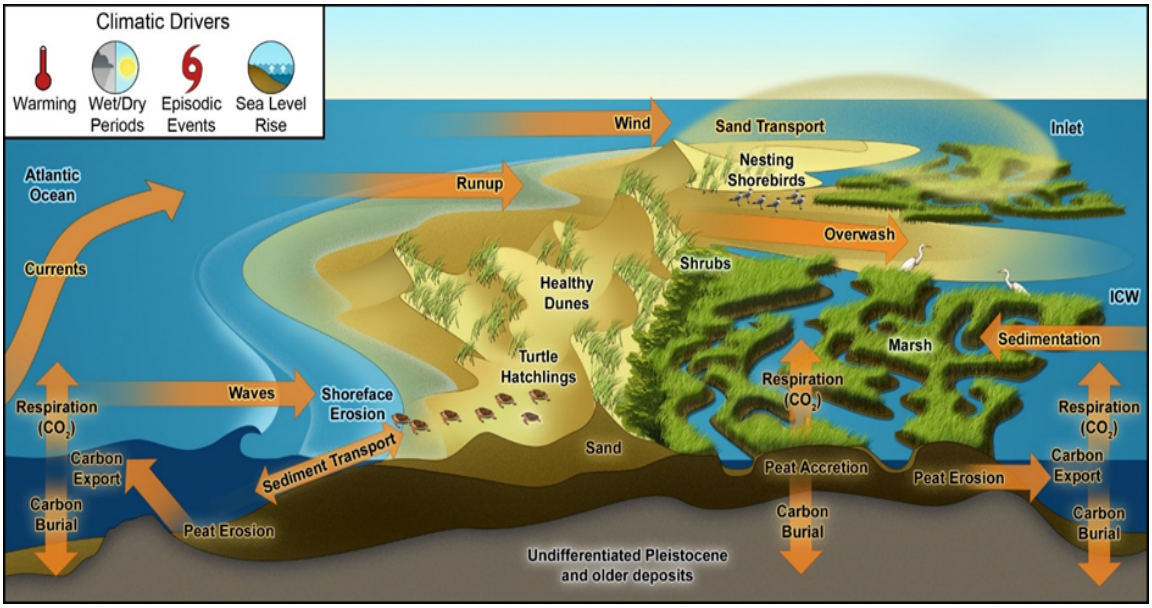
Question 1: What types of permits, approvals, and environmental studies will likely be needed to develop and implement a removal plan for the Southern Component of the New Inlet Dam? Describe the approach the firm will take to inventory these.

RESPONSE:

Cardno will work closely with the State of North Carolina (NC), Department of Environmental Quality (DEQ) - Division of Coastal Management (CAMA) to develop a clear understanding of the goals and objectives of the project for the removal of the southern component of the New Inlet Dam. We will coordinate with the NCDEQ to develop a clear and concise project description along with initial maps of the proposed project which will develop the foundation for identification of environmental and economic considerations for the removal plan. A clear project understanding will assist us in developing a project framework and an organized approach to scheduling and conducting necessary studies, surveys and regulatory requirements to obtain local, state and federal authorizations for the project.

Cardno's technical experts are well versed in complex environmental assessments and predicting the effects of developments in and infrastructure removal from coastal/estuarine systems. Our team of engineers, coastal and aquatic ecologists, modelling experts and economists have previously addressed similar issues associated with complex projects involving environmental, social and economic impacts. The range of issues within the coastal barrier and estuarine ecosystems that may be potentially affected by the removal (i.e., interactions among hydrodynamics, water quality, habitat, and ecological health) is illustrated in the following





conceptual diagrams (US DOD Defense Coastal/Estuarine Research Program based in the Marine Corp Base Camp Lejeune North Carolina, Onslow Beach). In addition to the ecosystem and coastal processes, the potential impacts to socio-economic conditions, recreation, and tourism as well as the navigation channels and the Port of Wilmington infrastructure would also need to be considered. Cardno will initially conduct an environmental constraints analysis and gather high level information about the project site, surrounding waterbodies, lands and communities to further refine our analysis of environmental considerations, scientific and engineering analysis and regulatory concerns.

Numerous local, state, and federal agencies will be involved in various roles from issuing permits or regulatory authorizations to review, coordination or as a commenting agency for the project so it is vital to develop a clear and streamlined approach. Coordination and communication with several of these entities is recommended well in advance of beginning the permitting process in the case where the regulatory phase may be lengthy. A list of most, but not all agencies or interested parties that will likely have an active role in regulation of this project are presented in Table 1. A prescribed framework will be developed that identifies the necessary studies, data, permits, licenses or authorizations and will be incorporated into a project schedule to track progress.

Table 1 A List of Potential Regulatory and Commenting Agencies

Agency Name	Agency Role
U.S. Army Corps of Engineers (USACE)	Permit – Section 10 of the Rivers and Harbors Act of 1899; Section 404 of the Clean Water Act; Section 401 Water Quality Certification; Section 408 (Requests to Alter U.S. Army Corps of Engineers Civil Works Projects Pursuant to 33 USC 408)
National Marine Fisheries Service (NMFS)	Environmental Analysis Review, Fisheries Issues, Essential Fish Habitat, Protected Species
U.S. Fish And Wildlife Service (USFWS)	Approval for adjusting the boundary of the Zeke's Island Research Preserve, Environmental Analysis Review, Fisheries issues, Rare, Threatened and Endangered Species

U.S. Coast Guard (USCG)	Environmental Review, Navigation
U.S. Environmental Protection Agency (USEPA)	Permit – Dredge Water Discharge (Environmental Analysis Review)
NC Department of Commerce – Visit North Carolina	A coordination department, business unit of Economic Development Partnership of North Carolina.
NC State Environmental Review Clearinghouse	Letter of Concurrence and Full Consistency of the Federal Activity in Accordance with the State's Approved Coastal Management Program
NC State Historic Preservation Commission	Historic and Cultural Resource Review
NC State Office of Archaeology	Permit or Coordination of historic and underwater archaeology, and survey of land and sea properties in NC.
NC State Division of Energy, Mineral and Land Resources	Coordination and commenting agency
NC State Division of Marine Fisheries	Coordination and commenting agency for the sustainable marine and estuarine fisheries and habitat
NC State Wildlife Resources Commission	Coordination and commenting agency that works to conserve and sustain the state's fish and wildlife resources
Local districts, cities, and counties and others	Permits or commenting agencies - Land Use, Coastal Development Permit, SEPA Environmental Review
Port of Wilmington	Coordination and commenting agency that manages commerce and goods and services to the State of North Carolina

Meeting with the necessary regulatory agencies early and often in the process is a critical component to officially identify lead agencies and roles and responsibilities and to obtain consensus on the project framework. Based on our experiences, streamlining project permitting involves listening to agency concerns and adapting recommended project components through design studies or changes. Initial agency meetings and discussions will provide important information regarding environmental considerations; required data, fisheries, wildlife, water quality, sediment, and specific agency-desired survey and study designs. To help with the efficiency of agency reviews and eliminate duplication of efforts throughout the project it is recommended that Memorandum of Understandings (MOUs) with clearly defined agency roles and responsibilities are executed by all agencies that assert jurisdiction.

During initial agency introductions, engaging in a discussion with the historic preservation and cultural resource agencies will be important. The New Inlet Dam is listed with the North Carolina Historic Preservation Office with site registry number BW0248 described as an 18,000 foot stone levee. Historical records indicate the New Inlet Dam contributed to the economy of the region. It appears that the structure may be eligible under criteria A for the listing on the National Register of Historic Places where the structure may be associated with events that have made a significant contribution to the broad patterns of United States history.

Following these agency meetings, the project management plan (PMP) and schedule will be revised with specific tasks, activities, milestones, resource allocations, and event durations then implemented. Cardno will work closely with the NCDEQ to inventory and gather existing data, past surveys, publications and peer reviewed literature regarding the surrounding areas for review. An electronic inventory of all data sources reviewed, content discovered, and

citations will be utilized to keep track of research, categorize information, and make it accessible to the project team. Data gaps and necessary survey and engineering studies will be identified and scopes of work will be developed. A general list of studies and surveys that most likely will be necessary are as follows, but not limited to:

- *Biological studies, including threatened and endangered species*
- *Sea turtles*
- *Benthic survey and assessment*
- *Avian surveys with emphasis on nesting shorebirds*
- *Fish population study*
- *Water quality assessment of water bodies associated with the project*
- *Hydrodynamic modeling*
- *Numerical coastal process modeling*
- *Sediment transport modeling*
- *Salinity modeling*
- *Habitat evaluations*
- *Mitigation planning*
- *FEMA Flood assessment*
- *Risk analyses*
- *Human and recreational use surveys*
- *Economic impact study*
- *Review of navigation data*
- *Historic structures review*
- *Review of satellite imagery, aerial photographs, meteorological, and socio-economic data*

Cardno is experienced working for government agencies and fortune 100 companies with managing large volumes of documents and content by implementing information management systems that serve as the system of record. These tools include project information management systems (PMIS), online document management systems, web GIS systems, and other database applications that are custom developed or implemented utilizing commercial off the shelf (COTS) software such as SharePoint©, Oracle, and other environmental compliance data management software.

The National Environmental Policy Act (NEPA) process is the evaluation of the relevant environmental effects of a federal project or action mandated by NEPA. This process begins when an agency develops a proposal addressing a need to take action. If it is determined that the proposed action is covered under NEPA, there are three levels of analysis that a federal agency must undertake to comply with the law. It is likely that this project will result in the preparation and drafting of an environmental impact statement (EIS). NEPA establishes this national environmental policy by requiring federal agencies to prepare an environmental impact statement to accompany reports and recommendations for Congressional funding. A project is required to meet NEPA guidelines when a federal agency provides any portion of financing for the project or review of a project by a federal employee can be viewed as a federal action which requires NEPA-compliant analysis. ***Cardno has prepared over 500 EA, EIS, and EIA documents, which demonstrates our extensive experience under NEPA****. We have extensive experience developing the project purpose and need, conducting scoping meetings and public meetings, and preparing the necessary and required*

Cardno was recently selected by the National Fish and Wildlife Foundation (NFWF) to support the development of NEPA documents for 46 grantees funded by the Hurricane Sandy Coastal Resiliency Grant program.

documentation in accordance with NEPA. To avoid the preparation of multiple EIS documents for different federal agencies, Cardno will work with NCDEQ and the lead NEPA agency to prepare the appropriate documentation. Cardno recommends holding monthly interagency coordination meetings during the NEPA process within the vicinity of the proposed project. This successful approach was administered on dozens of Cardno NEPA projects. Most recently, Cardno was selected by the National Fish and Wildlife Foundation (NFWF) to support the development of NEPA documents for 46 grantees funded by the Hurricane Sandy Coastal Resiliency Grant program. The program is funded by the U.S. Department of Interior (DOI) and supports projects that reduce communities' vulnerability to the growing risks from coastal storms, sea level rise, flooding, erosion, and associated threats from storm events. Grantees receiving NEPA assistance from Cardno include non-profit 501(c) organizations, state government agencies, local governments, municipal governments, Indian tribes, and educational institutions.

The New Inlet Dam is situated among many communities, public lands, and public access areas such that public outreach and engagement with these stakeholders will be an important component. Cardno has extensive public outreach and involvement experience related to regulatory and environmental actions. Our experiences provide us with the ability to easily facilitate communications with the public, communities, specific stakeholder groups, including legislators, NGOs and agencies. In addition to the environmental considerations, we understand this project occurs in an area with significant tourism, attracting visitors for the beach, historical tours, birding, fishing, and various other outdoor adventures such as kayaking and hiking. Cardno has extensive experience facilitating public meetings that address complex issues, and we understand how important it is to communicate complex concepts, issues, and challenges strategically and directly. It is our goal to achieve a shared understanding of the project and to engage the public during important project milestones. We regularly conduct public meetings on a national scale and have a successful public outreach track record in the State of North Carolina. One example is described in the table below titled Watershed Prioritization Tool which was developed to facilitate meaningful stakeholder input and enhance buy-in for a local watershed planning process, Cardno used Net Environmental and Community Benefit Analysis (NECBA), a rigorous, collaborative decision- making model that uses stakeholder-identified criteria to score potential mitigation projects and establish priorities.

Watershed Prioritization Tool, North Carolina	
Client:	
North Carolina Ecosystem Enhancement Program	
Summary:	Key Services:
To facilitate meaningful stakeholder input and enhance buy-in for a local watershed planning process, Cardno used Net Environmental and Community Benefit Analysis (NECBA), a rigorous, collaborative decision- making model that uses stakeholder-identified criteria to score potential mitigation projects and establish priorities. The NECBA approach has several benefits: • Provides a flexible platform for identifying and discussing goals and metrics for evaluating alternative projects. • Helps reduce conflict and build consensus by helping stakeholders articulate their preferences and understand the preferences of others.	> **Public meetings and facilitation** > **Benefit analysis** > **Decision support and prioritization tool**

Watershed Prioritization Tool, North Carolina	
• Facilitates stakeholder understanding of the trade-offs among alternative projects and explore compromise alternatives. For the Indian and Howard's Creek Local Watershed Plan, Cardno built the NECBA model through a series of stakeholder engagement activities, which included online surveys, stakeholder meetings, and webinars. Cardno employed a widely used statistical model to then infer the weight, in percentage terms, that the stakeholders gave to each metric and group.	

Question 2: Describe the firm's experience working with the types of permits, approvals, and environmental studies identified in Question 1 above. List all certifications and licenses the firm holds that are relevant to this work.

RESPONSE:

Cardno has a local understanding of the coastal communities and their culture with "boots on the ground" staff along the coast and our local offices in Raleigh and Charlotte. We understand the technical complexities of sensitive environmental issues, such as nesting sea turtles, and it is standard for us to present project details in an accurate and simplified manner, easily understandable to all types of public audiences.

Two brief project descriptions are provided below to illustrate our experience with permitting complex projects. The most similar project (Evaluation of Impacts of Additional Surface Water Withdrawals on the Lower Tar River and Pamlico Estuary) was evaluated through cooperative efforts with a Technical Advisory Committee that included various state and federal agencies (NC Division of Water Resources, NC Division of Water Quality, NC Wildlife Resources Commission, NC Division of Marine Fisheries, National Oceanic and Atmospheric Administration national marine fisheries unit, and the US Fish and Wildlife Service). The Castle Hayne Aquatic Resources Characterization project provides another example of a recent project that involved permitting, modeling, and ecological assessments. Many of the project examples that are included in other sections of this submittal also included a permitting component.

Evaluation of Impacts of Additional Surface Water Withdrawals on the Lower Tar River and Pamlico Estuary, North Carolina	
Client:	
Greenville Utilities Commission	
Summary:	Key Services:
Cardno is supporting Greenville Utilities Commission's (GUC) long-term water supply planning efforts by modeling the current and future flows and water availability in the Tar River and evaluating the environmental flow needs for fisheries and aquatic life, water quality, and other beneficial uses. Recent droughts and state-mandated 75% reductions in groundwater withdrawals from coastal Cretaceous aquifers in the North Carolina's Central Coastal Plain Capacity Use Area (CCPCUA) by 2018 are prompting greater use of surface waters in coastal North Carolina. Cardno is conducting an environmental flow study to determine the amount of water available from the Tar River for use by GUC for regional water supply purposes.	> **Technical advisory group consultation** > **Basin hydrologic analysis and modeling** > **Fish and habitat needs** > **Tidal freshwater habitats**

Evaluation of Impacts of Additional Surface Water Withdrawals on the Lower Tar River and Pamlico Estuary, North Carolina	
Designed and conducted in coordination with a multi-agency Technical Advisory Group (TAG) the results of the flow study will provide GUC with: (1) the ability to determine the amount of water available seasonally from the Tar River; (2) identify the environmental constraints to flow and withdrawals in the Tar River and provide the basis for impact analyses of habitat and aquatic resources; (3) address short-term and long-term water planning, permitting, and operational needs and develop flow strategies that balance water availability and protection of aquatic resources. The Flow Study consists of a series of interrelated tasks, including agency consultation, detailed study plan, river modeling, habitat analysis, reporting, agency meetings, and discussions and negotiations with the agencies in regard to flows appropriate for the Tar River. Simulation models and habitat analyses include a basin hydrologic model of existing and future flows in the Tar River, a hydrodynamic and water quality model that will simulate tidal conditions, flow, salinity, and water quality in the tidally-influenced sections of the river, and an aquatic habitat model.	> **Hydrodynamic and water quality modeling**

Castle Hayne Aquatic Resources Characterization, Northeast Cape Fear River, North Carolina	
Client:	
Titan America, LLC.	
Summary:	Key Services:
Cardno has conducted aquatic resource characterization surveys in the Northeast Cape Fear River and Island Creek, a tributary to the Northeast Cape Fear, and adjacent freshwater tidally influenced wetlands and canals on the former Ideal Cement Plant Mine property in Castle Hayne, NC. These studies were being conducted in support of a U.S. Army Corps of Engineers (USACE) Draft Environmental Impact Assessment (DEIS) for proposed mine expansions being prepared for Carolina's Cement LLC, a subsidiary of Titan America LLC. Aquatic resource elements being characterized within the project area include biological resources (fish, amphibians and benthic invertebrates), surface water quality, aquatic sediment chemical analyses, wetland, water and sediment quality, and aquatic habitat characterizations. In addition to aquatic resource evaluations Cardno coordinated with other consultants on risk assessment tasks associated with the DEIS, by developing approaches for estimating mercury concentrations in fish and applying available mercury data, assumptions and simple modeling approaches. Data collected from aquatic resource surveys and modeling efforts had been used to develop the aquatic resources section of the DEIS and to evaluate alternatives associated with the proposed mining expansion.	> **Biological resources characterization** > **Aquatic habitat characterizations** > **Water quality and sediment sampling and analysis** > **Hydrodynamic and water quality modeling**

A list of Cardno's Relevant Certifications and Licenses for North Carolina based staff (copies available upon request):

- *Professional Engineer (PE); North Carolina Board of Examiners for Engineers and Surveyors, License #032728 - Alix Matos*
- *Certified Wildlife Biologist (The Wildlife Society) - Olivia Munzer*
- *U.S. Army Corps of Engineers Wetland Delineation – Olivia Munzer*
- *Register of Professional Archaeologists; Certification ID 32554200 – Valerie Robbins*
- *North Carolina Board of Examiners for Engineers and Surveyors Business License for practicing engineering and land surveying, License #F-1316*
- *North Carolina Board for Licensing of Geologists, License #C-474*

- *In regards to General Business Licenses for the Cardno offices in North Carolina (as well as all other North Carolina municipalities), the Privilege License Tax has been repealed, effective July 1, 2015. As a result, the City of Raleigh no longer requires a Business License to operate a business within the Raleigh City Limits. The North Carolina General Assembly passed House Bill 1050 which eliminated the authority of municipalities to levy a business license tax. Cardno has two operational North Carolina based offices below:*
  - *7606 Whitehall Executive Center Drive, Suite 800, Charlotte, NC 28273*
  - *5400 Glenwood Avenue, Suite G-03, Raleigh, NC 27612*

2. Topic 2: Costs and Benefits Analysis

Question 1: Describe the firm's experience in conducting costs and benefits analyses. List all certifications and licenses the firm holds that are relevant to this work.

RESPONSE:

Cardno has a long and successful record of conducting objective and impartial economic and environmental studies. Our team is known for developing high quality, thorough analyses that involve quantifying and monetizing complex environmental goods and services. We excel at quickly identifying the key elements of an analysis and conducting thorough and incisive research that we communicate in clear, concise terms to our client and the public. Our team also has demonstrated experience eliciting stakeholder feedback and input, which is often a key component in evaluating difficult to quantify environmental and social impacts. Below we highlight several key projects with similar scopes of services, including those that demonstrate our ability and approach to conducting cost-benefit assessments in a variety of contexts.

Clients benefit from the wealth of knowledge and experience provided by our multi-disciplinary team of economists and environmental scientists.

The team assembled for this NCDEQ project represents the breadth of knowledge embodied in our international staff of economists, modelers, ecologists, archaeologists, and environmental scientists. Our Raleigh based team has a strong local understanding of the economy and environmental conditions unique to the Cape Fear River region. Together the core team members represent decades of experience performing complex economic and environmental analyses related to valuing complex environmental goods and services. Often relied on in both permitting and litigation settings, our work is recognized as both innovative and technically defensible. The table in Appendix A summarizes the experience and qualifications of our core team members that includes economists as well as environmental scientists, engineers and modelers. Combined, they have over 200 years of experience conducting environmental and economic valuation studies that estimate the environmental impacts resulting from natural or manmade activities as well as the benefits of outdoor recreation and changes in ecosystem services. Cardno's multi-disciplinary team with in-house staff will share responsibility for ensuring the delivery of a quality analysis that comprehensively and efficiently identifies and quantifies the economic benefits and costs associated with the removal of the southern portion of the New Inlet Dam. Three example projects are provided in the tables below that demonstrate the wide range of cost benefit analyses that Cardno has conducted. We provide

additional examples of our demonstrated experience throughout our responses to the questions under Topic 2.

Economic Benefits and Alternatives Evaluation of the Natural Resources Plan, Tennessee

Client:	
Tennessee Valley Authority	
Summary:	**Key Services:**
Cardno worked closely with natural resource specialists at the Tennessee Valley Authority (TVA) to quantify the benefits and prioritize four Natural Resource Plan (NRP) management alternatives for recreation, cultural, biological, and water resources on 293,000 acres of TVA-managed lands. Based on extensive interviews with the TVA project team and analysis of the resource changes that would result from the NRP programs, the Cardno team defined six types of economic benefits generated by the NRP management alternatives. Cardno economists estimated the economic value of benefits in dollar terms using a broad array of environmental economics literature applied to the specific conditions of the TVA programs. Nearly all quantified benefits of facilities, resource enhancement, and educational programs were related to recreation, including trails, greenways, wildlife viewing opportunities, and overnight and day use facilities. Results from this process were used in a decision-making framework to compare the benefits of the four management alternatives under different future conditions.	> **Quantify benefits** > **Estimated value of economic benefits** > **Use a decision making framework to compare benefits**

Economic Impact of an Improved Chicago River, Friends of the Chicago River, Illinois

Client:	
Friends of Chicago River	
Summary:	**Key Services:**
Cardno assisted a partnership of non-profit groups with estimates of the economic impacts and potential benefits of investments in river-improvement programs that generate economic activity in related industries and produce recreation, scenic, and real estate amenity benefits. The project team developed cost estimates for a green infrastructure capacity target, estimated the wastewater treatment costs saved by using green infrastructure, and conducted input/output modeling to estimate the economic activity associated with the investments. The team also conducted a survey of stakeholders regarding their uses of the River and opinions on how improved access contributes to quality of life. The project provided decision-makers with quantified estimates of the potential economic activity, cost savings, and public support generated by water quality investments.	> **Economic impacts and potential benefits** > **Evaluation of improved river access** > **Stakeholder surveys for use of the river**

Assessing the Costs and Benefits of Deep-Sea Mineral Mining, Secretariat of the Pacific Community, Fiji

Client:	
State of Queensland/Griffith University	
Summary:	**Key Services:**

Assessing the Costs and Benefits of Deep-Sea Mineral Mining, Secretariat of the Pacific Community, Fiji	
Cardno conducted an in-depth cost-benefit analysis of deep-sea mineral (DSM) mining in three Pacific island countries: Papua New Guinea, the Cook Islands and the Republic of Marshall Islands. The cost-benefit analysis included the cataloguing, quantifying and monetization of various financial, social and environmental costs and benefits of mining projects including offsetting carbon dioxide emissions, restoring deep-sea ecosystem services, and accidental oil spills and/or releases to the citizens of the host country. As part of this analysis, Cardno conducted dozens of in-person interviews with relevant stakeholders in order to discuss the importance of difficult to quantify cultural and social impacts. Cardno also used IMPLAN© (Impact analysis for PLANing) input-out modeling software to measure the total economic impact of DSM mining to each country	> **Cost-benefit analysis** > **Stakeholder engagement** > **Modeling**

A list of Cardno's Relevant Certifications and Licenses for North Carolina based staff (copies available upon request):

- *Professional Engineer (PE); North Carolina Board of Examiners for Engineers and Surveyors, License #032728 - Alix Matos*
- *Certified Wildlife Biologist (The Wildlife Society) - Olivia Munzer*
- *U.S. Army Corps of Engineers Wetland Delineation – Olivia Munzer*
- *Register of Professional Archaeologists; Certification ID 32554200 – Valerie Robbins*
- *North Carolina Board of Examiners for Engineers and Surveyors Business License for practicing engineering and land surveying, License #F-1316*
- *North Carolina Board for Licensing of Geologists, License #C-474*
- *In regards to General Business Licenses for the Cardno offices in North Carolina (as well as all other North Carolina municipalities), the Privilege License Tax has been repealed, effective July 1, 2015. As a result, the City of Raleigh no longer requires a Business License to operate a business within the Raleigh City Limits. The North Carolina General Assembly passed House Bill 1050 which eliminated the authority of municipalities to levy a business license tax. Cardno has two operational North Carolina based offices below:*
  - *7606 Whitehall Executive Center Drive, Suite 800, Charlotte, NC 28273*
  - *5400 Glenwood Avenue, Suite G-03, Raleigh, NC 27612*

Question 2: Describe the firm's ability and approach to conduct a costs and benefits analysis on the following topics as they relate to the proposal to remove the Southern Component of the New Inlet Dam:

RESPONSE:

The ultimate goal of a cost-benefit analysis is to determine whether a proposed action or project results in an efficient allocation of society's scarce resources. It requires an accounting of all of the economic costs and benefits (i.e. direct and indirect effects) of the proposed activity from the perspective of society. The outcome will determine whether the benefits of the proposed activity outweigh the costs, and by how much relative to other alternative actions (i.e. status quo or do nothing). In other words, how will the benefits and costs of the proposed activity be distributed across different population groups? Who gains (receives the benefits) and who loses (bears the cost) from the implementation of the project, and by how much?

To answer these questions, Cardno's approach begins by cataloguing and quantifying all of the various negative (i.e. costs) and positive (i.e. benefits) impacts associated with the proposed

project action. The next step involves assigning a dollar value to these impacts. The dollar value is intended to reflect society's willingness-to-pay to obtain (in the case of benefits) or avoid (in the case of costs) the specific project-related changes. The intent of assigning each change a monetary value is to convert the disparate changes that may result from a project, such as increased tax revenue, decreased ecosystem function, increased risk of flood damage, into a common unit (dollars) to help decision makers evaluate the proposed change.

Some of these impacts can be monetized using market data (i.e. revenues, costs, etc.), whereas others require the use of non-market approaches to capture the value of environmental and social impacts to society. To quantify the impacts that are not captured by the market, Cardno offers the potential to use a combination of the following approaches: 1) benefits transfer, a technique where willingness-to-pay values are adapted from existing literature and studies and applied to the area under investigation, or 2) conduct primary site-specific research (i.e. onsite surveys, in-person interviews, stakeholder engagement etc.) to obtain monetary values where appropriate (i.e. recreational use, property values).

The output from the combined approaches is a list of the costs and benefits of project actions divided into two categories. Those that can and will be monetized will be included in the cost-benefit analysis. Those that cannot be monetized will be discussed qualitatively. For those that can be monetized, all monetary values of project impacts are adjusted to reflect their present value. The difference between the total present value of benefits and the total present value of costs is defined as the project's net social benefit. If the project has positive net social benefits, then it has the potential to make society better off relative to the status quo or "do-nothing" scenario. To account for the uncertainty inherent in these values, Cardno will specify changes and/or willingness-to-pay as probability distributions and use Monte Carlo[1] methods to perform the analysis.

a. Environmental impacts including hydrology (e.g., salinity regime, tidal prism, and currents), sediment dynamics, habitat distribution, species distribution and utilization, and water quality to the Zeke's Island Reserve, lower Cape Fear River, and other special economic and natural resource assets in the immediate vicinity of the New Inlet Dam;

RESPONSE:

The lower Cape Fear River and estuary is a well-studied system, and there are at least two hydrodynamic models of the system that have been developed (Figure 1). Cardno's hydrodynamic modelers would initially review existing empirical and hydrodynamic models to determine the feasibility of using existing models to simulate the impacts of removing the New Inlet Dam on the hydrology, salinity regimes, sediment dynamics, habitat distribution, and impacts to sensitive and economically important species.

[1] Monte Carlo simulation is a problem solving technique used to approximate the probability of certain outcomes by running multiple trial runs (simulations) where inputs are randomly drawn from a distribution.

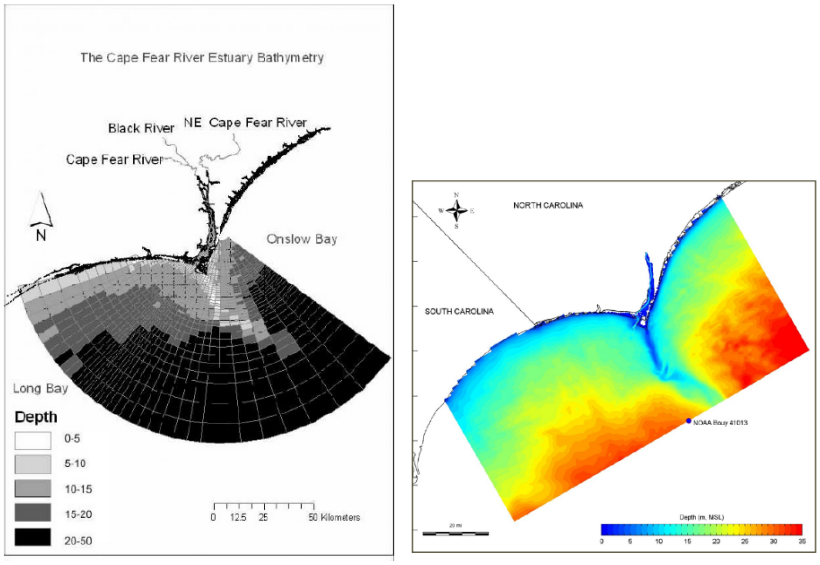
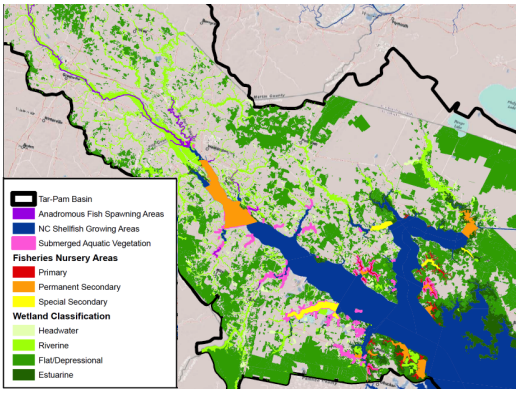


Figure 1 Existing hydrodynamic model grids of the study area: Left using the Environmental Fluid Dynamics Code and Right using the Delft3D model.

*We used a similar approach for a project for the **Evaluation of Impacts of Additional Surface Water Withdrawals on the Lower Tar River and Pamlico Estuary**. For this effort, we started with a hydrodynamic model developed by researchers at North Carolina State University and modified the model to address the specific questions related to permitting additional withdrawals from the river. For example, we conducted bathymetric surveys and collected side scan sonar images that allowed us to extend the model grid upstream from Washington, NC to Greenville, NC. To address the many complexities associated with the project, we worked with a Technical Advisory Committee that included various state and federal agencies (NC Division of Water Resources, NC Division of Water Quality, NC Wildlife Resources Commission, NC Division of Marine Fisheries, National Oceanic and Atmospheric Administration national marine fisheries unit, and the US Fish and Wildlife Service). At the end of our project, the NCDWR adopted our revised hydrodynamic model to address the mandate to develop hydrologic models of every river basin in NC. The State's existing model which relied on a mass balance approach using the OASIS model was not sufficient to address the Lower Tar and Pamlico estuary where the hydrodynamics of the system are dominated by tidal influences.*



A key output of this modeling project was determination of how the salinity regime in the lower Tar River and Pamlico estuary would change due to increased water withdrawals to meet 2050 and a hypothetical 2090 water use scenario. The results of these simulations were overlain on geographic datasets provided by the state agencies including high priority habitats and wetland areas. The salinity preferences and tolerances of the species associated with those areas was then compared to the frequency and duration of changing salinity regimes to determine the potential impacts to habitat and species. The hydrodynamic model was also used to assess impacts of altered water depths and velocities to address physical habitat changes.

We recommend a similar approach for the evaluation of the New Inlet Dam removal using one of two previously developed Cape Fear River Estuary hydrodynamic models developed by researchers at North Carolina State University (Xia et al. 2007) or by Olsen Associates, Inc. (2012). An initial scoping level evaluation of the model is recommended to determine if particular changes to input files and model development are needed to address the study questions (e.g., is the grid resolution fine enough to simulate the effects of removing this structure). Development and coordination with a Technical Advisory Committee will be critical to the project's success to ensure that the unique characteristics of the Lower Cape Fear River and estuary are properly addressed.

Once the impacts to physical and chemical habitat are understood, these environmental and ecological impacts will be further analyzed by Cardno's economists to evaluate the cost and benefits associated with these changes. In a similar project for the ***National Quantification of the Environmental and Social Impacts of Closed-Cycle Cooling, Electric Power Research Institute, Various locations****, Cardno was part of a team contracted by the Electric Power Research Institute (EPRI) to quantify on a national basis, the net environmental and social effects (adverse and beneficial) of retrofitting power plants with once through cooling to closed cycle cooling. Cardno's primary role on the project was the economic valuation of changes that would occur. These changes included reduction in the number of fish killed by power plants as well as changes in CO2 emissions, air quality, public safety, land use, water consumption, habitat quality, noise levels, and aesthetics. The impacts were quantified at individual nuclear and fossil fuel sites operating on a variety of water body types and under a range of geographic and socioeconomic conditions. Cardno used benefits transfer and bio-economic modeling methods to estimate social willingness to pay for the suite of associated environmental changes. The valuation included an assessment of the potential for non-use values based on existing literature and economic theory, interpretation and application of hedonics and travel cost literature, as well as application of agricultural economics paradigms.*

Cardno conducted a study on the ***Economic Impacts of the Sebastian Inlet, Sebastian Inlet Commission, Florida*** *that measured the regional economic benefits and impacts of maintaining the Sebastian inlet in Florida. The study is estimating how recreational boating and other activities are dependent on the inlet to support the economies of local communities within the political boundaries of the Sebastian Inlet District. A large component of the effort involved market surveys of boaters and marine recreation businesses. Cardno conducted a mail survey of 750 registered boaters and two online surveys – one for boaters and one for marine related businesses such as marinas, hotels, restaurants, and charter boats. Additional parts of the study measured the increase in costs for regional boaters and fishermen to access offshore waters via other inlets if the Sebastian Inlet were not navigable, and how the presence of the inlet influences local property values. Lastly, the analysis estimated the economic value of key natural resources sustained by the presence of the inlet. In particular, the inlet is vital for nearby seagrass ecosystems ("marine prairies").*

The project description provided in the table below provides an additional example of how Cardno evaluated the cost and benefits associated with designating critical habitat areas on public recreational lands for the US Fish and Wildlife Service and National Oceanic and Atmospheric Administrations.

Economic Impact to Recreation from Critical Habitat Designation for the U.S. Fish and Wildlife Service (USFWS) and National Oceanic and Atmospheric Administration (NOAA)	
Client:	
USFWS and NOAA	
Summary:	Key Services:
Cardno estimated the economic impacts of proposed critical habitat designation for species listed under the Endangered Species Act. These analyses have included assessing the net cost and potential impact of critical habitat designation on public recreation lands and recreationists, including campers, boaters, wildlife-viewers, Off Highway Vehicle (OHV)-users, and anglers. This work has included reviewing site and region-specific recreation participation and use literature; estimating recreation user days; and analyzing the impact on recreationists of changes in instream flow on anglers and boaters, including changes in facility supply, recreation user days, and recreation benefit.	> **Assessing net costs** > **Evaluation of recreation participation and benefits**

b. Navigational access impacts to the Port of Wilmington and for other commercial and recreational vessels;

RESPONSE:

Cardno has extensive experience in planning navigation access for ports, commercial maritime and military terminals and recreational facilities, such as marinas. In so doing, Cardno economists, engineers and planners have provided estimates of costs for improvement (deepening and widening) and maintenance for dredging and dredge material disposal as well related infrastructure upgrades. Benefits are estimated by continuing or developing new capabilities to move waterborne commerce or attract/maintain water-dependent users. With improvements in navigation access, transportation cost savings are possible, which make up an important component of the benefits side of the analysis.

Cardno uses an in-house database of harbor and navigation improvement costs that are based upon actual bids and industry standards. Cost estimates from RS Means are used that adjust for local conditions. Surveys of local businesses, like dredging contractors, are also used to reflect the most recent bidding climate. Cost estimates are itemized by line and aggregated with appropriate escalation factors to account for the time value of money. It is envisioned that once the Dam is removed that accumulated sediment behind the Dam and subsequent sediment loads would flow downstream and enter the Lower Cape Fear River. As sediment is transported into the navigation channel for the Port of Wilmington, the amount of sediment at first flush of Dam removal and annual loads of upstream sediment would increase the amount of the periodic dredging needed to maintain the 42 feet navigation channel. Disposal of these increased loads would follow existing options of beach nourishment, upland and off shore placement. Costs for dredging (hydraulic and/or mechanical) and disposal would be the cost side of the cost and benefits analysis for the impacts of the Dam removal on the Port of Wilmington, other commercial users and recreational vessels.

Benefits calculations would follow the USACE's Institute of Water Resources procedures. There would likely be positive effects from an enhanced habitat and water quality perspective as the river would flow without impedance from the Dam. Potential land use changes currently below the Dam may occur and could include commercial maritime

operations that would be able to take advantage of close proximity to the open ocean. Transportation cost savings could be estimated based on potential waterborne trade that could result from the project. The resulting costs and benefits analysis would include use of a current discount rate that reflects the future value of money for civil works project such as the proposed Dam removal.

Cardno recently worked with the USACE, Galveston District in the re-evaluation of costs and benefits with a new ***Widening Proposal for the Navigation Channel to the Port of Freeport, TX****. Costs were estimated for deepening new areas of the channel and the upland disposal of an additional 2 million cubic yards of dredge material. Several altered infrastructure costs were also included such as the protection of existing flood protection barriers and the relocation of utilities. Benefits were estimated for the new ability to accommodate larger ships including container ships and petroleum carriers. Working with the USACE, the costs and benefits analysis showed a greater than 1.5 ratio. This work allowed the continuation of the process of consideration to re-evaluate the previously Congressional approved navigation improvement project in Port Freeport.*

Our ports and harbors staff have an in depth knowledge and understanding of big picture shipping routes, waterborne cargo forecasts, and vessel traffic at ports of call along the east coast including the Port of Wilmington. Our understanding of maritime routes and the needs of associated commercial vessels will help us to assess navigation access impacts and the potential viability of new routes. Cardno completed a ***Programmatic NEPA document for the US Maritime Administration (MARAD)*** *on the feasibility and evaluation of a maritime highway. The study included a marine highway evaluation of the east and west coasts of the United States. Elements of the project studied a potential shift of commercial cargo from trucks to domestic shipping routes. On a smaller scale pertaining to recreational vessel access, Cardno brings the qualifications and experience with regional economic benefit analysis of inlet structures on the viability, importance and use of coastal inlet areas from the recreational vessel and boating perspective like our project Economic Impacts of the Sebastian Inlet.*

c. Economic factors including cost and maintenance of removal, cost and maintenance of restored condition, and changes to commercial and recreational use of the area;

RESPONSE:

Cardno's team includes a geomorphologist, Dr. Andrew Simon, with over 30 years of experience in evaluating and management of sediment erosion and transport. Prior to joining Cardno, Dr. Simon has conducted his career with the US Geological Survey for 16 years and the USDA-ARS, National Sedimentation Laboratory for 15 years. Cardno's geomorphologist has an expertise in mechanistic analysis of unstable-channel systems, erosion, cohesive-sediment entrainment, the role of

riparian vegetation, "reference" sediment-transport rates, and river restoration, working on projects throughout the United States and around the globe. Mr. Simon and his team are experts in quantifying the effects of imposed channel and landscape disturbances, and mitigation measures on channel response and sediment loads. Cardno's geomorphologists and hydrodynamic modelers would work together to evaluate the existing information and modeling regarding sediment dynamics in the estuary before and after removal of the dam. Our staff's qualifications would perfectly enhance the analysis of sediment loads, physical characteristics and modeling reactions including effects on the existing navigation channel and the Lower Cape Fear River by the removal of the dam. Coupled with our overall approach and techniques of cost benefit analysis, Cardno's geomorphologists would consider the potential for adjustments and evolution of the channel in coordination with our navigation experts with respect to shifts in the navigation channel and how that may positively or adversely affect commercial and recreational vessel of the area and ingress/egress. In order to evaluate the economic factors for removal and maintenance of the Lower Cape Fear River and adjacent tributaries, Cardno would evaluate current and future sources and magnitudes of sediment delivery, quantify potential sediment-load reductions or additions, and determine "background" rates of sediment transport.

Two brief project descriptions are provided in the tables below that describe similar projects that included sediment modeling.

Murray River Mouth Barrage Removal and Dredging Program, Australia

Client:	
Murray-Darling Basin Corporation and South Australia Department of Water, Land & Conservation	
Summary:	Key Services:
A 5 year study involving application of the Delft3D numerical modelling suite to simulate sediment transport and morphodynamics of the Murray River entrance (Australia's largest river with a catchment similar in size to the Mississippi River). Existing barrages that prevent saline ocean water ingress into Lake Alexandrina were assessed through simulating a range of options involving adjusting the dredging program and barrage operation and location. Optimal solutions were derived from a cost-benefit analysis.	> **Delft3D Numerical Modeling** > **Wave, tide and freshwater simulations** > **Dredging** > **Cost-benefit analysis**

Sediment Load Reduction to the Great Barrier Reef and Moreton Bay. Queensland

Client:	
State of Queensland and Griffith University	
Summary:	Key Services:
The project, conducted in cooperation with the Australia Rivers Institute at Griffith University and the U.S. Army Corps of Engineers focuses on determining magnitudes and sources of sediment moving from three important Queensland catchments (Normanby, O'Connell and Upper Brisbane) to their respective outlets. In particular, the project focuses on using state of the art field and analytic techniques to measure and predict bank erosion using a new modeling framework that combines the industry standard HEC-RAS sediment-transport model with the Bank-Stability and Toe-Erosion Model (BSTEM) of which Dr. Simon is the senior developer. As lead scientist for Cardno, Dr. Simon designed and is conducting a multidisciplinary study using detailed geomorphic and numerical modeling investigations of the three representative	> **USACE partnership** > **Modeling** > **Sediment transport and erosion**

Sediment Load Reduction to the Great Barrier Reef and Moreton Bay. Queensland	
watersheds with reconnaissance-level evaluation of more than 300 sites to be used for extrapolation of erosion rates to un-modeled reaches.	

Boone Dam Remediation Socioeconomic Report and Environmental Assessment Tennessee Valley Authority, Tennessee	
Client:	
Tennessee Valley Authority	
Summary:	Key Services:
Boone Dam, owned and operated by the Tennessee Valley Authority (TVA), impounds Boone Reservoir, a multi-use reservoir primarily providing flood protection and recreation opportunities to a three-county region in northeastern Tennessee. In October 2014, a sinkhole was discovered near the base of the embankment at Boone Dam compromising the safety of the dam. TVA chose to remediate the problem by constructing a composite seepage barrier at Boone Dam over a period of 5 to 7 years. During the remediation period the reservoir pool elevation would be roughly 10 feet below winter pool levels, eliminating or severely limiting access to the reservoir. Cardno developed the socioeconomics assessment of TVA's action and wrote two sections for the EA; Recreation and Socioeconomics. The analysis focused on the impact that the reduced access to recreational amenities on the reservoir would have to visitors and shoreline property owners, both quantifying and qualifying the impacts. The report determined annual visitation to Boone Reservoir would decline between 24 percent and 52 percent of normal, reducing economic activity in the area by between $11 thousand and $290 thousand. And shoreline property owners' spending on recreation-related items would further reduce economic activity by between $630 thousand to $1.2 million	> **Analysis of reduced access to recreational amenities** > **Economic impact to recreation** > **Changes to recreational use**

d. Beach erosion and sand management for adjacent and surrounding beach communities; and

RESPONSE:

When beaches are narrowed by erosion there are multiple economic impacts: recreational opportunities may decrease, the quantity and quality of ecosystem services may be altered, and coastal infrastructure may be placed at greater risk. Some of the costs associated with these changes can be monetized using relatively straight-forward risk and engineering cost estimates. However, valuing changes in recreational opportunity and ecosystem service provision requires an extensive understanding of non-market valuation methods such as random utility models and conjoint analysis.

Working with biologists and physical oceanographers, Cardno economists will identify project-related changes in recreational opportunity and ecosystem service provision, quantify those changes in meaningful units such as lost beach trips, and assign a value to each change using benefits transfer methods that are both rigorous and technically defensible.

Alternatively, Cardno offers the option to collect site-specific visitation data at the beaches likely to be affected by the project. The visitation data would be used in combination with data on beach characteristics such as quality, width, etc., in a Random Utility Model (RUM) in order to estimate both the change in visitation and value per trip under current

and post dam removal conditions. This option has the advantage of producing a more precise estimate of the change in visitation and subsequent change in value associated with project related actions since it is based on specific data obtained at the affected sites as opposed to relying on data obtained from similar sites.

Cardno economists Jeff Wakefield, PhD and Kelley Myers, PhD have published empirical studies about the value of beach use in Delaware. Dr. Wakefield has also published work on the costs of nourishment on Delaware's ocean beaches. We have a partner relationship with Dr. George Parsons, University of Delaware, who has conducted multiple studies about the recreational use of beaches and recently assisted Delaware with an economic study of Bay beaches. Our combined experience in valuing the benefits of beach related activities and teaming relationships with leading academic experts in the field of recreational valuation will provide the State with scientifically sound and rigorous results. The table below provides an example of a cost benefit analysis that Cardno conducted in Australia for various coastal management strategies.

Quinn's Beach Long Term Coastal Management, Australia	
Client:	
The City of Wanneroo	
Summary:	Key Services:
Cardno was engaged to carry out a detailed coastal processes assessment, and investigate and prepare coastal management options for the long-term protection of Quinn's Beach. Shoreline evolution was modelled for both long-term trends and short-term storm-induced erosion using a number of 'best of breed' numerical model systems for waves, currents and sediment transport. This project represented the use of the XBeach model. Significant community engagement was facilitated through a Community Reference Group. Suitable coastal management options identified from a detailed cost-benefit analysis were assessed, and a preferred option selected based on a multi-criteria analysis that accounted for an extensive range of technical, economic, social and environmental considerations.	> **Coastal processes assessment** > **Shoreline evolution analysis** > **Modeling** > **Stakeholder engagement**

e. Storm vulnerability to the Zeke's Island Reserve, lower Cape Fear River, adjacent and surrounding communities, and other special economic and natural resource assets in the immediate vicinity of the New Inlet Dam.

RESPONSE:

Our firm has decades of experience with the preservation of coastal habitats and communities to ensure a resilient and sustainable future through evaluations and modeling in relation to vulnerability, natural hazards, climate change, and adaptive management measures. We have experience conducting a variety of vulnerability assessments in coastal habitats and communities. By focusing on storm vulnerabilities to community systems, Cardno can recommend reinforcement strategies and outline a multi-faceted approach to reduce community risk through measures that support infrastructure and ecosystem resilience while ensuring that actions are cost-effective and involve minimal reinvestment. The potential impacts related to storm surge, waves, and associated currents called storm vulnerability cannot be exactly determined; however,

with the use of modeling practices, potential scenarios can be simulated. Varying degrees of storm processes that may cause beach and dune erosion, overwash and onshore sediment transport can be evaluated along with associated risk factors. The Cardno team of coastal scientists, hydrodynamic modelers, and resiliency experts can utilize the most recently available information to evaluate the combined risk to the area from sea-level rise and storm surge. We use a high-resolution, site-calibrated, numerical model framework developed specifically for each project. Our models will quantify storm surge attenuation rates in the coastal community, including factors that contribute to vulnerabilities, and will provide information for management actions and resilience planning.

In addition, Cardno will evaluate the risks of the project and impacts from storm surges on threatened and endangered species, such as nesting sea turtles, as well as unique and sensitive natural areas, such as Zeke's Island Coastal Reserve. Our archeologists and historians will determine the potential impacts to cultural resources within the impact area.

The tables below provide examples of similar projects where Cardno evaluated storm surge, climate change, and/or coastal resiliency issues for NEPA compliance or to conduct cost benefit analyses.

NFWF Hurricane Sandy Coastal Resiliency Grant Program – Coastal Resiliency Assessments

Client:

National Fish and Wildlife Foundation

Summary:	Key Services:
NFWF, in partnership with DOI, is managing the Hurricane Sandy Coastal Resiliency Competitive Grants Program. The program selected 54 projects from Virginia to New Hampshire and as far west as Ohio - states that officially declared a natural disaster as a result of the Hurricane Sandy storm event. Grants were awarded to projects that assess, restore, enhance or create wetlands, beaches and other natural systems to help better protect communities and to mitigate the impacts of future storms and naturally occurring events on fish and wildlife species and habitats. DOI has invested funding in mapping, analysis, assessments, resiliency planning, and natural resource prioritizations that advance knowledge of the effects of climate change, sea level rise, and storm events on coastal natural ecosystems and communities. The assessments are designed to inform future management actions, policies and practices that can help natural resource managers and communities mitigate for the impacts of future storms and other naturally occurring events. The program will result in more than 6,600 acres of wetlands and marshes restored or created, 225 acres of beach restored, and over 216 million gallons of stormwater runoff reduced, as well as to benefit fish and wildlife. Cardno is providing technical assistance to these grantees by advising project managers on how to adequately document and perform quality control and quality assurance checks on their coastal resiliency assessment projects. Cardno's work with grantees ensures all data collection and processes funded by the grant meet agency regulations and are of the type and quality expected by NFWF, DOI, and other federal and state partner agencies.	> **Coastal resiliency assessment** > **NEPA guidance and documentation** > **Agency coordination**

Costs and Benefits analysis for Fraser Coast, Hervey Bay

Client:

Information that assists or otherwise relates to developing specifications for a solicitation by the State is deemed confidential until award of a contract in connection with such solicitation

Costs and Benefits analysis for Fraser Coast, Hervey Bay

Fraser Coast Regional Council

Summary:	Key Services:
Assessment of the costs and benefits of retreat versus protection of coastal infrastructure at risk from beach erosion. The Fraser Coast beaches have been retreating (in some locations at about 0.5 m per year) through erosion associated with tropical storms and hurricanes, which is being exacerbated by sea level rise. Significant infrastructure in the coastal zone is at risk and emergency evacuation plans are well developed to protect life during extreme events. Cardno assessed the costs and benefits of retreating (including methods for compensating coastal zone land owners) versus protecting coastal infrastructure over 20 and 50 year planning horizons	> **Costs and benefits analysis** > **Beach erosion** > **Storm vulnerability** > **Sea level rise**

Town of Broome Coastal Vulnerability Study, Australia

Client:

The Shire of Broome

Summary:	Key Services:
Cardno undertook the following assessments: storm surge and coastal inundation assessment, hydraulic assessment and shoreline stability assessment. Cardno developed a comprehensive coupled model system which simulated wind, atmospheric pressure, tide, rainfall and overland flow to investigate ocean inundation and catchment flooding. The study considered the impact of jointly occurring elevated ocean water levels and catchment flooding. The joint inundation and flooding model system also provided input to a hydro-geological model to assess interaction between surface water and ground water. The multidisciplinary team assembled by Cardno utilized the Delft3D model suite to provide rigorous model results in standardized formats that were readily transformed into visual products suitable for stakeholder engagement	> **Delft3D modeling** > **Hydraulic and shoreline stability assessment** > **Stakeholder engagement**

Southeast Florida Regional Vision and Blueprint for Economic Prosperity, Southeast Florida

Client:

South Florida Regional Planning Council

Summary:	Key Services:
Southeast Florida is on the cutting edge of global issues such as international immigration, trade, expansion of the Panama Canal resulting in increased commerce and trade at local Ports, growth and sustainability of coastal communities, communication, Everglades restoration, tourism and climate change. Under the Sustainable Communities Regional Planning Grant from the U.S. Department of Housing and Urban Development (U.S. HUD) solutions were developed to provide a model and blueprint for other regions for liveability and economic prosperity. With the growth of southeast Florida a plan was needed to couple growth and development through urban sprawl with the risks of storm vulnerability, aging infrastructure, population demands and affordable housing. Cardno supported this project through a rigorous science-based approach to sustainable planning through a sea level rise impact assessment, public engagement, and master planning and project management.	> **GIS mapping** > **Science-based approach to planning** > **Sea level rise impact assessment**

RESPONSE: *See responses to the above sub-elements of Topic 2.*

References

Olson Associates, Inc. 2012. Calibration of a Delft3D model for Bald Head Island and the Cape Fear River Entrance Phase I. Prepared for Village of Bald Head Island, April 2012.

Xia, Meng, Lian Xie, and Leonard J. Pietrafesa. Modeling of the Cape Fear River Estuary Plum. Estuaries and Coasts Volume 30, Number 4, p. 698-709.

ADDENDUM ACKNOWLEDGEMENT:

Cardno, Inc. acknowledges that we have received and incorporated the information included in Addendum 1 and Addendum 2.

Environmental Quality

PAT MCCRORY
Governor

DONALD R. VAN DER VAART
Secretary

BID ADDENDUM

FAILURE TO RETURN THIS BID ADDENDUM IN ACCORDANCE WITH INSTRUCTIONS MAY SUBJECT YOUR BID TO REJECTION.

Bid Number: 16-32314-WA Bid opening Date/Time remains: February 04, 2016

DISCRIPTION: **Analysis of removal of the Southern Component of the New Inlet Dam**

Addendum Number: 2

Addendum Date: January 11, 2016

INSTRUCTIONS:

On addendum number 1, the captions of the pictures are not clear and some of the letters have been cut off. The pictures are in the correct order. I have copied the captions on to a separate document as addendum number 2. It is not necessary for this addendum to be signed and returned along with your completed RFI but it is acceptable should you chose to do so.

APPENDIX A

Table A. Cardno Core Team Qualifications

Economists

Staff	Experience
Susan Burke, PhD ***Senior Consultant*** **PhD, Agricultural and Natural Resource Economics, Oregon State University** **MS, Agriculture and Natural Resource Economics, University of California – Davis** **BS, Finance/Business, California State University**	Dr. Susan Burke's nearly 20-year environmental management career has been devoted to water resource management and planning, specifically incorporating economics into resource management decisions. She is widely recognized for developing innovative ideas to problems faced by resource managers and skilled at working across various disciplines and with various governmental agencies – federal, state and local. Dr. Burke has served as the technical expert and lead on projects that evaluate the economic benefits of flood control, dam removal, watershed and estuary restoration, and outdoor recreation. Dr. Burke has extensive experience collaborating with hydrogeologists, biologists and ecologists. Her relevant experience includes: > Water Resource & Management > Water Economics > Cost-Benefit Analysis
Jeffrey Wakefield, PhD ***Senior Consultant, Principal*** **PhD, Economics, University of Delaware** **MS, Marine Biology & Biochemistry, University of Delaware** **BS, Biology, Rochester Institute of Technology**	Dr. Jeffrey Wakefield has over 15 years of experience actively managing and performing intergovernmental and private sector projects related to the valuation of natural resources and the modeling of economic impacts. He has carried out cost benefit analyses related to beach nourishment projects, Environmental Protection Agency (EPA) permitting activities and regional development plans. He has led numerous socioeconomic analyses for the Federal Energy Regulatory Commission (FERC), United States Coast Guard, U.S. Department of State, and the National Marine Fisheries Service which included implementation and/or review of multiple input/output modeling efforts. His relevant experience includes: > Economic Modeling > Cost-Benefit Analysis > Recreational Impact Assessment > Statistics
Heath Byrd ***Senior Economist*** **MS, Agricultural and Natural Resource Economics, Colorado State University** **BS, Environmental Economics and Management, University of Georgia**	Mr. Heath Byrd has over 16 years of experience developing socioeconomics analyses as part of environmental assessments (EAs) and environmental impact statements (EIS). He is currently leading an assessment of socioeconomic, recreational, and tourism impacts as part of a programmatic policy review concerning potential changes to TVA regulations. Mr. Byrd also has extensive experience estimating outdoor recreation-based visitation, including statistical analysis and sampling design as well as complex computer modeling. These skills have been applied to several high profile Natural Resource Damage Assessments (NRDAs), including the assessment of potential impacts to Florida recreation and tourism stemming from the Deepwater Horizon oil spill. His relevant experience includes: > Outdoor Recreation Visitation Estimation > Economic Value of Outdoor Recreation > Visitation Surveys > Statistics and Sampling Design > Computer Modelling

Staff	Experience
Kelley Myers, PhD ***Senior Economist*** **PhD, Marine Studies, University of Delaware** **MS, Economics, University of Delaware** **BS, Economics, Millersville University**	Dr. Kelley Myers is a senior economist with 10 years of experience in the economic valuation of natural resources. She has considerable experience in survey design and programming, facilitating one-on-one interviews and focus groups, stakeholder engagement and the valuation of complex environmental goods and services. She has also published her work and presented in the scientific and technical community. Since Joining Cardno she has designed several online surveys to estimate the benefits of outdoor recreation and water quality improvements, facilitated over 100 one-on-one interviews, helped develop a framework for a cost-benefit analysis of Clean Water Act regulations, and served as the technical lead on a cost-benefit study of mining for deep-sea minerals in the Pacific Island region. Her relevant experience includes: > Cost-Benefit Analysis > Stakeholder Engagement > Valuation of Ecosystem Services > Survey Design and Administration
Jessie Sutphin ***Economist*** **MA, Economics, Duke University** **BA, Business Administration, UNC-Charlotte**	Ms. Jessie Sutphin is a local economist whose technical experience includes data management, survey design and administration, and statistical data analysis. Ms. Sutphin has project related experience in estimating the benefits of outdoor recreation and property valuation as it relates to support for litigation. Her education includes formal training in theoretical and applied computational economics Her relevant experience includes: > Natural Resource Economics > Survey Development > Econometrics > Data Analysis
Oliver Pahl ***Senior Staff Economist*** **BS, Environmental Economics Policy & Management, minor in Natural Resource & Environmental Law & Policy, Oregon State University**	Mr. Oliver Pahl is a Senior Staff Economist with over four years of environmental consulting experience. He has experience working on Natural Resource Damage Assessments and NEPA environmental reviews with a focus on land use, recreation, visual resources and socioeconomics. He also has experience in land use planning and permitting, oil and gas leasing, and railroad operations management. His skills include economic impact analysis, data management, and data analysis including the use of the statistical software STATA. Since joining Cardno Oliver has worked in permitting, focusing on land use and socioeconomics, and natural resource damage assessment, focusing on human use valuation His relevant experience includes: > Environmental Economics > Natural Resource Damage Assessment > Land Use Planning > Natural Resource Valuation

Environmental Sciences

Andrew Simon ***Geomorphologist*** **PhD, Earth Resources, Colorado State University** **BA, Geography, State University of New York at Buffalo**	Dr. Andrew Simon is a geomorphologist with 30 years of experience in mechanistic analysis of unstable-channel systems, streambank erosion, cohesive-sediment entrainment, the role of riparian vegetation, "reference" sediment-transport rates, and river restoration, working on projects throughout the United States and around the globe. His interests are in quantifying the effects of imposed channel and landscape disturbances, and mitigation measures on channel response and sediment loads. He is an internationally recognized scientist and project manager, designing field, laboratory and numerical-modeling studies, leading and participating in field data collection, analyzing and synthesizing data, and preparing technical reports. He is the author of more than 100 technical publications and the editor of several books. His relevant experience includes: > Fluvial geomorphology > Streambank mechanics and modeling > Watershed scale evaluations of sediment transport > Effects of management actions on sediment dynamics
Paul Leonard ***Technical Director*** **MS, Fisheries Science/Statistics, Virginia Polytechnic Institute & State University;** **BS, Aquatic Science/Biology, Allegheny College**	Mr. Paul Leonard is a Technical Director with 30 years of experience managing and performing environmental assessments, restoration, and permitting related to energy, utility, transmission, land, and water resource development projects. Mr. Leonard regularly manages the activities of multi-disciplinary teams of fisheries biologists, hydrologists, water quality experts, planners, recreation specialists, and other environmental and resource specialists on large and complex projects. A well-regarded team leader, he directs major assignments with complex requirements for agency consultation, regulatory approvals, and alternative analysis. Mr. Leonard is a water resource specialist a recognized national expert in hydroelectric project licensing, NEPA compliance, watershed studies, and instream flow investigations. He specializes in instream flow studies of large rivers that require unique solutions for modeling of complex hydrologic and fisheries issues and assessment of multiple alternatives and project operations scenarios. His relevant experience includes: > Aquatic ecology > Ecological assessments > Environmental permitting and NEPA compliance > Instream flow analysis
David Van Senden, PhD ***Senior Principal*** **University of Western Australia;** **BSc(Hons), Flinders University of South Australia**	Dr. David van Senden has a PhD in coastal engineering and is a Senior Principal with Cardno. He has more than 25 years of experience and has lead the modelling component of multidiscipline projects to assess impacts of proposed developments, provide engineering design criteria for water infrastructure and developed models for the assessment of eutrophication effects in freshwater, estuarine and marine systems. Projects include assessment of the effects of desalination plant brine discharges into estuarine waterways, cold water pollution effects downstream of reservoirs and groundwater extraction fields, saline intrusions into upper estuarine reaches, mixing and stratification effects on water quality and ecosystem responses. He is proficient in the use of a number of numerical models including the Delft suite of 1-, 2- and 3- dimensional flow, transport (FLOW3D) and water quality models (DELWAQ) and the EFDC and wave models (SWAN and Boussinesq). He has also undertaken sediment transport modelling for rivers and coastal zones. His relevant experience includes: > Hydrodynamic and coastal modeling > Ecological effects of dredging on harbors > Assessment of dam removal projects > Natural Resource Valuation

Michael Hughes, PhD **Honorary Research Fellow, School of Geosciences, University of Sydney** **Editorial Board, Journal of Coastal Research**	Dr. Michael Hughes has over 30 years' experience across industry, government and university sectors. Michael has a strong technical background in coastal and ocean processes including internationally significant research; he has more than 100 publications and more than 1,000 citations in the Thomson-Reuters Science Citation Index. He has completed numerous projects involving science translation for policy makers. These include authoring the NSW Government's Coastal Hazard and Risk Assessment Manual and papers for the National Climate Change Adaptation Research Facility's CoastAdapt tool for local government authorities. Michael is an internationally recognized expert in coastal oceanography, morphodynamics (geomorphology) and sediment transport, and has worked on numerous coastal management projects. His relevant experience includes: > Integration and analysis of diverse data sets and model types to identify robust and cost effective solutions > Climate change and sea level rise impacts > Coastal hazard risk assessments and risk management plans > Beach and dune erosion, beach nourishment and dune rehabilitation
Steve Bartell **PhD, Oceanography & Limnology, University of Wisconsin** **MS, Botany (Plant Ecology), University of Wisconsin** **BA, Biology (Magna cum laude), Lawrence University**	Dr. Steven Bartell has extensive experience and technical skills in quantitative ecosystem analysis and ecological modeling. He has demonstrated modeling skills that include individual-oriented models, demographic population models, bioenergetics-based models of populations, communities, and ecosystems, and spatially-explicit watershed models. Dr. Bartell has applied these skills in assessing ecological risks posed by a variety of physical, chemical, and biological environmental stressors. He has also used his modeling skills in evaluating the likely outcomes of ecosystem management and restoration, quantifying population viability of endangered species, and characterizing basic ecosystem dynamics. Dr. Bartell has demonstrated experience in the development and application of methods for assessing the response of ecological and environmental models to inaccuracies and imprecision in model structure, model formulations, and parameter estimation. He has demonstrated expertise in Monte Carlo methods, interval analysis, fuzzy arithmetic, and computationally intensive methods (e.g., bootstrap, jackknife). His relevant experience includes: > Ecological Modeling and Risk Analysis > Science-Based Sustainability > Risk-Based Decision Analysis > Numerical Sensitivity & Uncertainty Analysis
Sharon Niemczyk ***Senior Consultant*** **BS, Biology/Marine Biology, Florida Institute of Technology**	Ms. Sharon Niemczyk has over 18 years of experience in the environmental sciences, natural resources management and regulatory review of complex environmental projects. She has developed an expertise in regulatory review of a broad spectrum of projects and management of coastal resources. She has experience with the NEPA process in both the public and private sector. She has proven experience in planning and strategic positioning for water and natural resource projects. She advises clients on environmental resource protection measures, streamlined project approaches and regulatory guidance with additional focus on minimization of resource impacts and water quality protection measures. Previously Ms. Niemczyk has worked for the Florida Department of Environmental Protection (FDEP) and the U.S. Army Corps of Engineers (USACE) where she primarily handled complex regulatory issues such as shore protection and ports and harbors projects. Her relevant experience includes: > Environmental permitting > Environmental impact assessment > Project and public meeting facilitation

Alix Matos ***Environmental Engineer*** **MS, Civil Engineering, North Carolina State University** **BS, Environmental Engineering, North Carolina State University**	Ms. Alix Matos, PE, is an environmental engineer with 15 years of experience assessing the impacts of human activities on the natural environment. She has developed hundreds of Total Maximum Daily Load (TMDL) studies across the country. Ms. Matos has expertise in water quality, wasteload allocation, and watershed modeling including evaluations of nutrient loading, eutrophication, fecal coliform, sediment, dissolved oxygen dynamics, and mercury transformations. Her experience in field monitoring studies includes flow measurement, sediment oxygen demand and re-aeration, time of travel determinations, water body surveying, streambank erosion assessment, and use of biological integrity indices. Much of this work has centered around predicting the impacts of land use changes, water withdrawals, pollutant discharges, and pollutant management strategies on water quality in streams, lakes, and estuaries. Her relevant experience includes: > Water quality and hydrologic modeling > Environmental impact assessment > TMDL assessment and modeling > Regulatory and permitting support
Robert Wardwell, MS, AICP ***Planner*** **MS, Science in Environmental Science, University of New Haven** **MS, Business Administration in Transportation/Logistics, University of Maryland** **BA, Economics, Marietta College**	Mr. Robert Wardwell is a Senior Professional with over 30 years of consulting experience in the fields of environmental planning, port planning and dredge material management. Mr. Wardwell is a Certified Planner through the American Institute of Certified Planners. He has managed many Environmental Assessments for infrastructure projects. He has continually worked as an environmental consultant and managed over 200 environmental documents, served over a decade as an Adjunct Professor at the Graduate School level and provided expert witness in state and federal court. He has specialized in undertaking technical studies and assisting in obtaining permits for dredging and navigation projects, having successfully worked with military and industry clients in completing dredging projects totally over 20 million cubic yards of marine sediment over the past 20 years. His relevant experience includes: > Economics > Transportation and navigation expert > Dredging and dredge material management expert > Certified Planner